Environmental Guidelines
Northern Seismic Operations

Prepared by:

Hardy BBT Limited

Calgary, Alberta
for:
Northern Affairs Program

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

Published under the authority of the
Hon. Bill McKnight, P.C., M.P.,
Minister of Indian Affairs and
Northern Development,
Ottawa, 1988.

QS-8416-000-EE-A1
Catalogue No. R72-205/1988E
ISBN 0-662-16370-2

©Minister of Supply and Services Canada

Cette publication peut aussi être obtenue
en français sous le titre:
Directives environnementales pour la
prospection sismique dans le Nord canadien

90-03051/

Table of Contents

Preface iv

Chapter 1: Introduction 1

- What is a Seismic Operation 1
- Purpose of the Handbook 2
- Handbook Organization 2

Chapter 2: Land Use Permits and Other Applicable Legislation 3

- Government in the North 3
- Acts and Regulations 3
- Permitting Procedures 5

Chapter 3: Permafrost and Seismic Operations in the North 7

- Definitions 7
- Distribution 7
- Characteristics 8
- Permafrost and Seismic Lines 8

Chapter 4: Planning 9

- Initial Contacts 9
- Collect Information 9
- Modify Route Alignment 10
  - Existing Seismic Lines, Roads, and Trails 10
  - Sensitive Terrain 10
  - Water Bodies 11
  - Special Areas and Concerns 11
    - Critical Wildlife Habitat 11
    - Unique Geographical Features 11
    - Archaeological Sites and Monuments 12
    - Commercial Forests 12
    - Mining Claims 12
    - Traplines 12
    - Pipelines 13
- Scouting 13
- Contractor Considerations 13
- Scheduling 14

Seismic Operations Planning Worksheet 15

Chapter 5: Clearing 19

- Cutting the Line 19
  - Equipment 19
  - Where to Clear 19
  - How to Clear 20
- Brush Disposal 21
  - Total Disposal 21
  - Partial Disposal 21

Chapter 6: On-Line Operations 23

- Travel on the Line 23
- Water Bodies 24
  - Fords 24
  - Ice Bridges 25
  - Snow Fills 25
- Camps 25
  - Where to Locate 25
  - Movement 26
  - Storage of Camps 26
  - Water Supply 27
  - Waste Water and Sewage 27
  - Garbage 28
  - Camp Access 28
    - Air 28
    - Road 29
  - Fuel Supply 30
  - Seismic Survey Techniques 30

Chapter 7: Clean-up and Restoration 31

- Timing 31
- Clean-up Requirements 31
  - Garbage 31
  - Shot Hole 31
  - Drainageways 32
  - Airstrips 32
  - Access Roads 32
  - Slopes 32
- Reporting 32

Recommended References 33

List of INAC Offices 34

Preface

Resource exploration and development in northern Canada involves a range of land use activities, including mineral and hydrocarbon exploration, the construction and maintenance of access roads, the clearing and preparation of hydrocarbon well sites, and the opening of borrow pits and rock quarries. To help the operators of small-to-medium scale projects carry out their activities in an environmentally acceptable manner, Indian and Northern Affairs Canada (INAC) has prepared a series of handbooks keyed to the operating conditions attached to land use permits. To date, five handbooks have been published:

"Environmental Guidelines Pits and Quarries"
"Land Use Guidelines Mineral Exploration"
"Land Use Guidelines Access Roads and Trails"
"Environmental Operating Guidelines: Hydrocarbon Well-sites in Northern Canada"
"Reclamation Guidelines for Northern Canada"

By following the guidelines in these handbooks, projects can be carried out with minimal environmental impact.

This handbook, the sixth in the series, is designed to assist operators in minimizing the environmental impacts of seismic operations in northern Canada.

The study team received valuable assistance and guidance from the Steering Committee composed of Ron Bailey, Floyd Adlem, and Joe Ballantyne from Land Resources, Northern Affairs Program, Indian and Northern Affairs Canada. Much of the technical input came from participants at a workshop on seismic operations held in December, 1987 in Calgary. The contribution of photographs and slides by the workshop participants is gratefully acknowledged.

This handbook was prepared by the Environmental Division of Hardy BBT Limited, Calgary, Alberta.

GUIDELINES PRESENTED HEREIN ARE SUBORDINATE TO ALL ACTS, ORDINANCES, AND REGULATIONS.

Chapter 1
Introduction

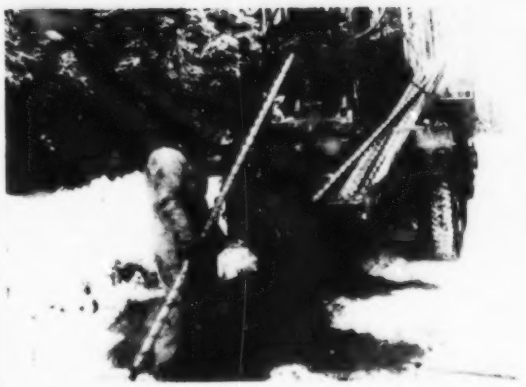
WHAT IS A SEISMIC OPERATION

Exploration for economic minerals (metallic, non-metallic, and hydrocarbons) relies heavily on remote detection techniques. The seismic method, with its high accuracy, high resolution, and great depth penetration, is the most common remote detection technique for hydrocarbon exploration. The technique uses elastic (seismic) waves which are artificially generated near the earth's surface to provide information on geologic structures and formations at depth. Explosives or other energy sources are used to generate the seismic waves at locations called shotpoints and detectors called geophones are used to measure the resulting motion of the earth. The data are usually recorded in digital form on magnetic tape so that computer processing can be used to enhance the signals and display the data for geologic interpretation.

• **surveying a seismic line**

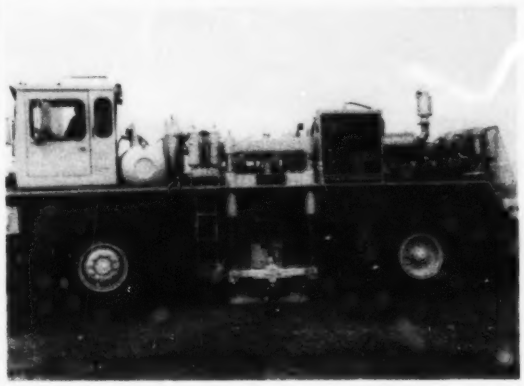
The most common energy sources for seismic surveys are explosives and hydraulic vibrators. When explosives are used as the energy source, holes called shot holes are drilled to allow the dynamite to be placed below the weathering layer. The holes are usually 8 to 10 cm in diameter and 6 to 30 m deep. Hydraulic vibrators pass energy into the ground by exerting a variable pressure on steel plates held against the ground by the weight of the vehicle. Vibrator equipment is normally mounted on a large-wheeled vehicle.

In a typical seismic survey, the first step is surveying and clearing the line and flagging the locations of shotpoints and geophone groups. These activities are carried out by the survey crew. Where explosives are used, the next step is the drilling of the shot holes and placement of



• **drilling shot holes for explosives**

the dynamite charges by the drilling crew. The seismic crew which follows consists of jug hustlers; a shooter, if necessary; and the recording crew. The jug hustlers lay out one or more cables, usually 2 to 4 km long, in a straight line away from the energy source. At regular intervals of 25 to 100 m along the cable, groups of geophones are connected. If explosives are used, a shooter follows to connect and detonate the charges. If vibrators are used, the vibrator vehicles are positioned at the shotpoints. Seismic waves originating at the shotpoints reach the geophone groups where they are converted into electrical signals which are amplified and transmitted to the recording vehicle. The collection of this data together with the co-ordination of the activities of the other crews is the responsibility of the chief observer of the recording crew. Following the survey, drilled holes are plugged and capped and capwire and pin flags are collected for disposal. In remote areas, cooking and sleeping facilities must also be provided.

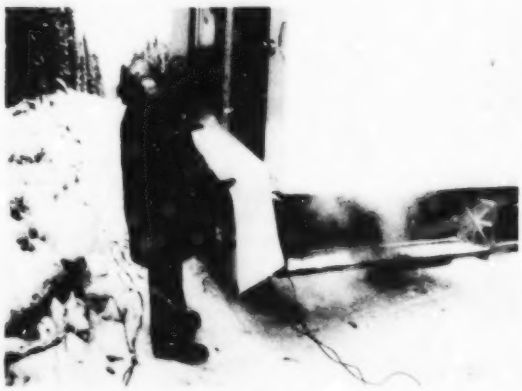


• **a hydraulic vibrator**

This can result in an operation of 60 or more personnel and a combination of both tracked and wheeled vehicles, depending on the time of year and access to an area.

• **detonating the charges**

The most common type of seismic survey is the 2-D survey described above. When more detailed information is required, a 3-D seismic survey, in which geophones or energy sources are laid out perpendicular to the survey line as well as along the line, may be carried out. While this technique requires additional survey lines, they can be narrower than the main survey line because the recording truck does not normally have to travel along them.

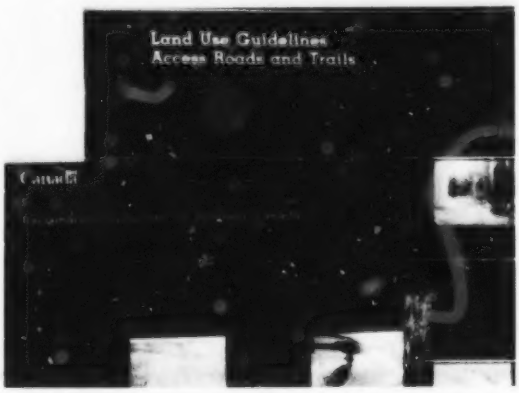


• **examining data readout following detonation**

PURPOSE OF THE HANDBOOK

This handbook is written to assist hydrocarbon and mineral resource companies and geophysical contractors in addressing the terms and conditions attached to their land use permits for seismic operations in northern Canada. It is also written to assist land use inspectors when advising seismic operators and when inspecting seismic operations. Although intended to stand alone, the handbook is complemented by the "Land Use Guidelines Access Roads and Trails" and "Reclamation Guidelines for Northern Canada" handbooks, both of which contain expanded discussions on some of the topics discussed herein. Familiarity with these other handbooks will be of benefit to the reader.

The procedures presented in this handbook focus on northern Canada where, because of distinctive climatic and terrain conditions, many aspects of seismic operations differ from those in southern Canada. The handbook provides environmentally sound, operationally feasible guidelines for conducting seismic operations in the north.



• **the reader will benefit through familiarity with these handbooks**

HANDBOOK ORGANIZATION

Chapter 2 discusses the land use permits and other applicable legislation.

Chapter 3 discusses permafrost and its relationship to seismic operations in the north.

Chapters 4 through 7 address seismic operations in northern Canada sequentially from the planning stage (Chapter 4) through clearing (Chapter 5), on-line activities (Chapter 6), and clean-up and restoration (Chapter 7). A seismic operations planning worksheet is included in Chapter 4.

The final portion of the handbook presents a list of recommended references and a list of INAC offices.

Chapter 2
Land Use Permits and Other Applicable Legislation

Seismic operations in northern Canada are regulated by various governmental agencies through several acts and regulations. A lack of understanding of government requirements and the permitting process can result in misunderstandings as to proper procedures and in costly time delays. In this chapter, the structure of the government in the North and the acts and regulations applicable to seismic exploration are outlined and the procedures to be followed in obtaining permits are explained.

GOVERNMENT IN THE NORTH

Most of the Northwest Territories and Yukon is federal Crown land, called territorial lands, administered for the federal government by INAC. Around many of the communities, the land has been transferred from the federal government to the territorial government. These lands, known as Commissioner's lands, were set up to allow territorial and community jurisdiction over matters affecting the community.

Portions of northern Canada are the subject of native land claims. In the Northwest Territories, areas subject to land claim negotiations are still accessible and under the jurisdiction of INAC. In the Yukon, areas which have been withdrawn from disposition pending a land claim settlement may be available for development following consultation with the concerned native bands.

For INAC administrative purposes, the Northwest Territories and Yukon have been divided into resource management areas as shown on the maps on page 4. The two regional offices are located in Yellowknife and Whitehorse.

Each resource management area has an office where land use permit applications are reviewed and assessed, and where contractors and operators can seek advice on environmental conditions and land uses along their proposed seismic line. The addresses of these offices are listed at the back of this handbook.

ACTS AND REGULATIONS

Various acts, ordinances, and regulations control land development in the North; however, only a few apply to seismic operations. The following are brief summaries of these.

Territorial Lands Act – provides the authority for dealing with the administration and protection of territorial (federal Crown) lands, which are under the direct control of the Minister of Indian and Northern Affairs.

Territorial Land Use Regulations – provides regulatory control for maintaining sound environmental practice for any land use operation on lands under INAC control in the territories. These Regulations require that land use permits be issued for all work involving the use of heavy equipment, establishment of camps, and clearing of lines, trails, and rights-of-way. The Regulations are administered by INAC land use engineers who review land use permit applications and issue land use permits. The Regulations also provide for land use inspectors, who conduct field inspections to ensure compliance with the Regulations and land use permits.

Canada Petroleum Resources Act – regulates oil and gas interests on Canadian lands. This act is administered by Canada Oil and Gas Lands Administration (COGLA), a federally-created agency composed of representatives from INAC and the Department of Energy, Mines and Resources.

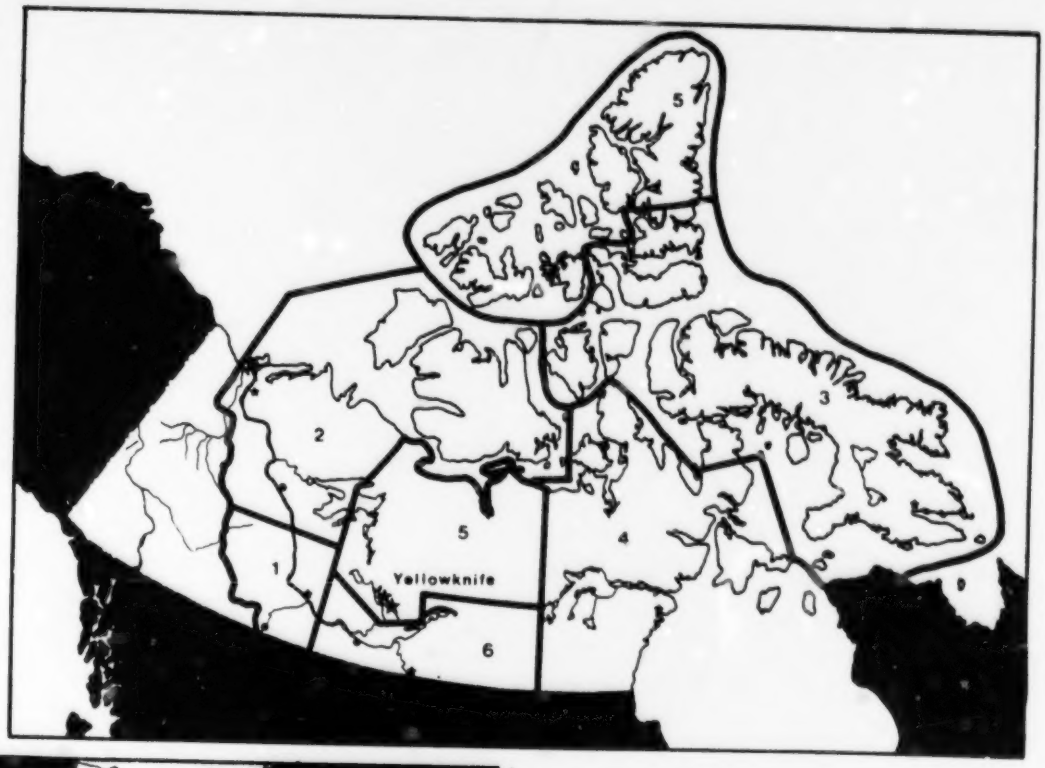
Fisheries Act – provides for the protection of fish and fish habitat from any interference through pollution or any structure that impedes or blocks fish movement.

Northern Inland Waters Act – provides for the licensing of water use, which serves as a means of controlling pollution by prohibiting waste deposition in any water body and supporting the establishment of a comprehensive water management program.

Mine Safety Ordinances and Rules – controls the use and storage of explosives in the Northwest Territories.

Yukon Blasting Ordinance – controls the use and storage of explosives in the Yukon.

• this publication will help explain some of the legislation you will have to follow



INAC RESOURCE MANAGEMENT AREAS

Northwest Territories:

1. Ft. Simpson
2. Inuvik
3. Baffin
4. Keewatin
5. Yellowknife and Arctic Islands
6. Ft. Smith

INAC RESOURCE MANAGEMENT AREAS

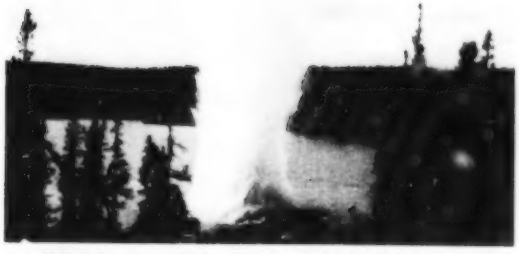
Yukon

1. Watson Lake
2. Teslin
3. Tagish
4. Laberge
5. Haines Junction
6. Beaver Creek
7. Carmacks
8. Ross River
9. Mayo
10. Dawson

Most of the requirements relating to these acts and regulations will be included in the terms and conditions attached to the land use permit required for seismic operations. Their inclusion does not mean, however, that the acts and regulations themselves can be ignored. The contractor and operator should become familiar with these pieces of legislation. The INAC publication "A Guide to Territorial Land Use Regulations" is a good starting point for this purpose.

PERMITTING PROCEDURES

Before commencing a seismic operation, certain permits must be obtained. A land use permit issued by INAC will be required, as will a permit from COGLA if the operation involves exploration for hydrocarbons. Others that may or may not be required include a burning permit, if there is to be any burning of brush (in the Northwest Territories, these permits are issued by the Government of the Northwest Territories), and if there is to be blasting on or in any water body, a fisheries permit. An additional land use permit may be required if a large staging area (e.g. adjacent to a river or lake), separate from the actual seismic program, is used.



• a fisheries permit is required if blasting on or in a water body

THE HOLDER OF THE MINERAL RIGHTS APPLIES FOR THE LAND USE PERMIT.

The application for a land use permit is made by the holder of the mineral rights for the survey route or the holder's manager. The application cannot be made by the geophysical contractor performing the survey.
When preparing your land use permit application, mark the proposed location of your seismic survey line, camps, and airstrips on topographic maps. Maps at a scale of 1:50 000 are preferable but not always available, in which case maps at 1:250 000 should be used.

Aerial photographs with the lines and camps on them are not suitable for land use permit submissions because they are not satisfactorily reproducible by photocopiers.

The permit application should also indicate the type of equipment to be used and the name of the contractor, although applications without a contractor's name are still acceptable. Determine the type and size of equipment that will be used based on the type of program, timing, and terrain and climatic conditions along the route.

INCLUDE SAME-SEASON, FOLLOW-UP SURVEYS ON YOUR APPLICATION

If there is a possibility that a follow-up seismic survey may be required in the same season, indicate the possibility on your application. By doing so you may be able to decrease the amount of effort and time needed for approval to carry out the additional survey. However, depending on the extent and location of the additional survey, you may be required to re-apply for a new land use permit.

Once the application is submitted and accepted as being complete, it will be passed on to members of the Land Use Advisory Committee and to potentially interested communities for review. The Land Use Advisory Committee includes representation from territorial and federal government agencies including INAC, Environment Canada, and Fisheries and Oceans Canada. Native bands potentially affected by the operation are also consulted.

• make early contact with government departments to determine permitting requirements

Following this review, the recommendations go to the land use engineer who does one of three things with the application. The engineer may:

(1) Issue a land use permit with appropriate conditions for environmental protection

(2) Refuse to issue a permit and provide the reasons therefore

3) Place the application on hold while the project is studied in more detail

In most cases a land use permit is issued within 42 days of submission. When possible, it is a good idea to make your application in the spring or summer so that if field inspections are required as part of the permit assessment they can be carried out under optimum conditions. A permit from COGLA may take 10 working days to obtain. Therefore, it is advisable to submit your COGLA application at the same time as your land use permit application.

READ YOUR LAND USE PERMIT

Once you have received your permits, make sure you read them. The terms and conditions attached to the permit are intended to protect the environment and the permit holder is responsible for compliance. If, for whatever reason, circumstances prevent you from complying with a term or condition, notify your land use officer and your situation will be assessed. The Land Use Regulations provide a process for appealing any of the terms and conditions attached to a permit. This appeal is made directly to the Minister of Indian Affairs and Northern Development, not to the land use engineer.

Upon your land use permit being issued, a land use inspector will be assigned to your operation. The land use inspector now becomes your main INAC contact for the operation. Inspectors are appointed by the Minister and their decisions can be appealed only to the Minister. INAC encourages problem solving by its inspectors but will undertake enforcement action through the courts as required.

In most cases, the land use inspector will meet with the permittee/contractor at project initiation, conduct field inspections during operation, and carry out a final inspection when the project is complete. This latter inspection is necessary before the land use inspector can recommend that the land use engineer grant final clearance on the operation. Where necessary, a progress reporting schedule will be established by the land use inspector. The land use inspector will also be available to assist and advise an operator on environmental matters.

Chapter 3
Permafrost and Seismic Operations in the North

The land north of 60° includes a wide range of vegetation, terrain, and climatic conditions. As one moves northwards, coniferous forest gradually gives way to open woodland, tundra, and polar desert in response to increasingly cooler and drier conditions. Much of the land is flat to gently rolling, yet portions are covered by mountain ranges that extend arctic tundra conditions southwards into the forest region. Permafrost underlies much of the land.

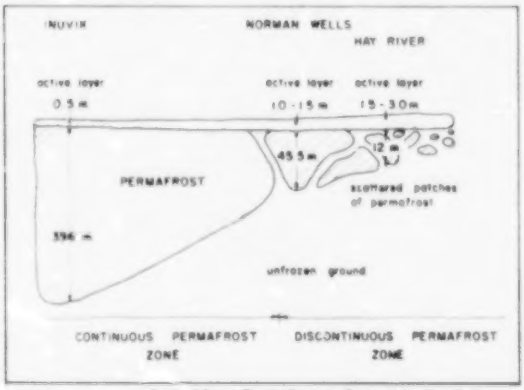
Although many of the principles of seismic operations in southern areas can be applied in the North, they must be modified in response to permafrost which influences terrain stability and drainage.

DEFINITIONS

Permafrost is ground that remains frozen through at least two consecutive winters and the intervening summer. It can consist of mineral soil, organic soil, or rock, and can be either ice-free or ice-rich. Permafrost varies in thickness from a few centimetres near the southern limits of its range to several hundred metres in the north. An annually thawed zone, called the active layer, overlies the permafrost. This active layer varies in thickness from 15 to 60 cm in the north to several metres in the south.

DISTRIBUTION

Permafrost is found across northern Canada. Its distribution is divided into two zones: the continuous zone and the discontinuous zone. In the continuous zone, permafrost is present under all land surfaces; active layers are thin and permafrost is thick. In the discontinuous zone, permafrost is found under certain conditions only. Typically, these include north-facing slopes, muskeg, and shaded terrain with minimal snow cover. In the northern portions of this zone, the permafrost is widespread; in the southern portions it is scattered. Discontinuous permafrost also occurs in the mountains, south of the permafrost limit.



adapted from *Permafrost in Canada* by R.J.E. Brown

- **continuous and discontinuous permafrost**
- **active layer**

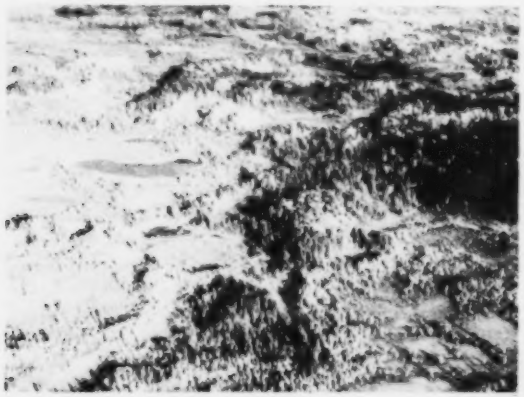
adapted from *Permafrost in Canada* by R.J.E. Brown

CHARACTERISTICS

Permafrost is sensitive to changes in ground and air temperature. It is protected from these changes by the organic mat, which acts as insulation, by the shade provided to the surface by trees, shrubs, and grasses, and by snow.

Water, which acts as a conductor of heat, greatly influences the distribution of permafrost and as a result the permafrost table is depressed under lakes and streams. Water is also an effective erosive agent of frozen soils. In winter, the blockage of subsurface drainage by frozen soils or roadbeds can force groundwater to come to the surface, resulting in a build-up of ice and the consequent formation of icings or "glaciers" as they are sometimes called.

When the insulating layer is disturbed or removed, permafrost thaws. If the soil is ice rich, slumping, sliding, and other forms of erosion may occur. Ice-free soils show little physical change if permafrost thaws.



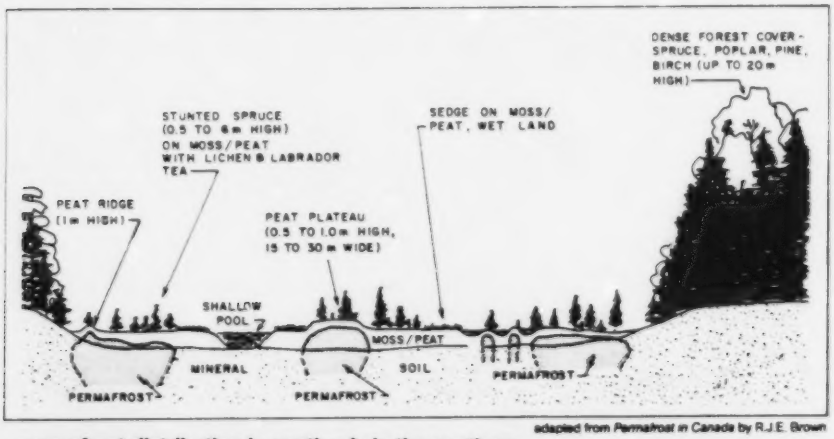
• **typical terrain in the discontinuous permafrost zone**

• **removal of the surface organic mat in ice-rich soil caused extensive thawing and erosion**

PERMAFROST AND SEISMIC LINES

PRESERVE PERMAFROST DURING SEISMIC OPERATIONS

Seismic operations have the potential to disrupt the ground thermal regime in permafrost areas, causing thawing of the permafrost and initiating erosion. Care must be taken to avoid rutting the surface and damming drainageways because of the resultant concentration of water which can warm the permafrost. Likewise, removal of the surface organic mat will expose the permafrost to thawing. The following chapters will present suggested seismic operational procedures to minimize such disturbances.


DENSE FOREST COVER - SPRUCE, POPLAR, PINE, BIRCH (UP TO 20 m HIGH)
STUNTED SPRUCE (0.5 TO 6 m HIGH) ON MOSS/PEAT WITH LICHEN & LABRADOR TEA
SEDGE ON MOSS/PEAT, WET LAND
PEAT RIDGE (1 m HIGH)
PEAT PLATEAU (0.5 TO 1.0 m HIGH, 15 TO 30 m WIDE)
SHALLOW POOL
MOSS/PEAT
MINERAL SOIL
PERMAFROST
PERMAFROST
PERMAFROST

adapted from *Permafrost in Canada* by R.J.E. Brown

• **permafrost distribution in peatlands in the southern fringe of the discontinuous zone**

Chapter 4
Planning

PLANNING IS AN ENVIRONMENTALLY AND ECONOMICALLY WISE MOVE

Planning is an important part of any land use operation – it can save both time and money and minimize the chances of adverse environmental impacts. Several land use permit terms and conditions, covering topics such as the location of lines in relation to streams, cutting of stream banks, and location of fuel storage sites, can be addressed during the planning stage, thus averting problems during the field operations.

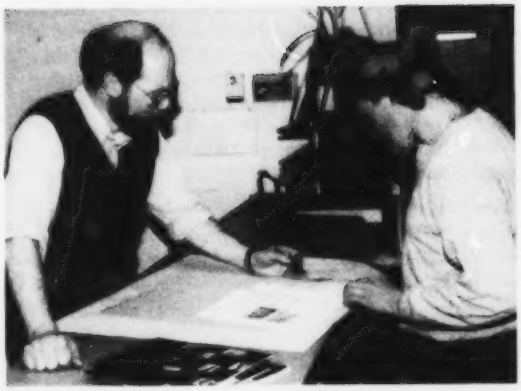
In this chapter, procedures for planning a seismic operation are outlined. A worksheet to use during planning appears at the end of the chapter.

• plan to use existing rights-of-way wherever possible

INITIAL CONTACTS

MAKE EARLY CONTACT WITH YOUR LAND USE ENGINEER

Early in the planning stage, once the seismic program has been defined, contact the INAC land use engineer in the program area to introduce yourself and the program and gather some information on conditions in the area. At this stage the route of the seismic line will have been determined based on the geology of the area. The land use engineer will have information from previous operations in the area and also on other land interests. INAC encourages communication between the permittee and land use engineer at this early stage. The better the engineer understands the project, the easier it is for him when drawing up the land use permit terms and conditions.



• collect information at your INAC office regarding conditions and previous operations in your project area

COLLECT INFORMATION

Seismic line planning should include the collection of terrain, climatic, and land use information on the program area and the interpretation of this information to determine alignment modifications, program scheduling, and logistics. Information can be collected from published air photos, maps, and reports; from individuals who have carried out seismic operations in the area; and from scouting activities.

CONTACT OTHER SEISMIC OPERATORS

Other seismic operators who have worked in the area of your proposed program are an invaluable source of information regarding what you may expect to encounter. Conversations with other operators may help to identify problem terrain, stream characteristics, special requirements by communities along the route, and other concerns not readily apparent on maps and in reports. This information will supplement that obtained through discussions with the land use engineer.

CHECK MAPS OF EXISTING SEISMIC LINES, ROADS, AND TRAILS

Names of other seismic operators who have worked in your proposed program area and the location of existing seismic lines, roads, and trails, some of which you may be able to incorporate into your proposed line, can be obtained from INAC. Maps of most existing seismic lines in the Northwest Territories and Yukon are available in blue-line form at a scale of 1:250 000 at the Yellowknife and Whitehorse offices.

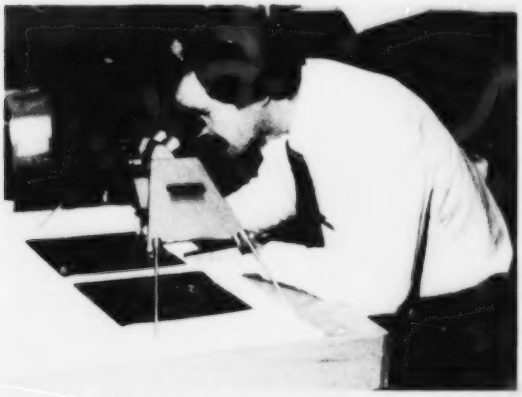
Maps of existing roads and trails in the Yukon are available for viewing, but not distribution, at the Whitehorse office.

COLLECT TERRAIN, CLIMATIC, AND LAND USE INFORMATION

Information on the presence and ice content of permafrost is important, for both logistics and data interpretation. Permafrost and other terrain information is available in reports and open files of the Geological Survey of Canada. Topographic and surficial geology maps provide terrain and drainage information. Aerial photographs, whether black and white, colour, or from Landsat, are essential for route planning because of the terrain information they provide.

Collect climatic data on the area from forestry offices and airports. This data will assist in planning by indicating when to expect freeze-up and adequate snow cover and when to expect break-up.

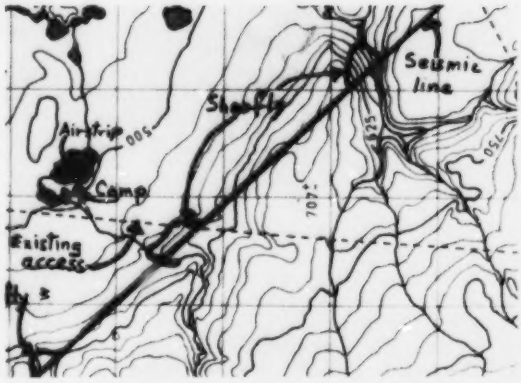
The location of important archaeological sites in the Northwest Territories can be obtained from the Prince of Wales Northern Heritage Centre in Yellowknife.



• use aerial photographs to examine terrain and to aid in route selection

MODIFY ROUTE ALIGNMENT

After analyzing the available information, the proposed seismic line alignment can be modified to account for the existence of other seismic lines, roads, and trails; sensitive terrain; water bodies; and special areas and concerns. Potential camp and airstrip locations, fuel storage sites, potential access problems, and water body crossings can be determined at this time.



• indicate routes and location of airstrips, camps, etc. on the topographic map accompanying your application.

Existing Seismic Lines, Roads, and Trails

USE EXISTING RIGHTS-OF-WAY

Wherever possible use existing seismic lines, roads, and trails for travel. Incorporate existing lines into your proposed line, if appropriate. These actions will minimize the amount of new clearing required and will decrease the potential for erosion.

Sensitive Terrain

AVOID ICE-RICH TERRAIN

Patterned ground and fine-textured soils, both indicators of ice-rich permafrost, should be avoided wherever possible. If avoidance is not possible, take special care not to destroy the organic mat.

• avoid patterned ground in route selection

LOCATE SHOOFLIES

Identify steep slopes where access may be a problem and the potential for erosion may be high. Determine potential locations for shooflies to allow equipment to move down the slope on gentler grades.

Choose level, stable terrain for locating camps and airstrips.

• determine potential location for shooflies at steep slopes

Water Bodies

MAINTAIN A BUFFER BETWEEN THE LINE AND WATER BODIES

Identify locations where the proposed seismic line parallels water bodies. Ensure that a 30-metre buffer is provided between the water body and the line to reduce the possibility of erosion and deposition of material into the water body. There may be cases, however, where water bodies are too numerous and close together for the 30-metre buffer to be maintained.

When crossing water bodies, choose locations with gentle approach slopes and cross at right angles.

Do not locate fuel storage sites near water bodies. Fuel should be stored on high ground, at least 12 m above the normal high water mark of any water body. This will minimize the potential for leaks or spills to enter the water.

Special Areas and Concerns

If a seismic line crosses especially sensitive or unique areas, there will be terms and conditions in the land use permit addressing these. Permafrost, lakes, and streams can be sensitive, and these have been discussed above. Other potentially sensitive areas that should be considered at the planning stage are:

- Critical wildlife habitat
- Unique geographic features
- Archaeological sites and monuments
- Commercial forests
- Mining claims
- Traplines
- Pipelines

Critical Wildlife Habitat

AVOID IMPORTANT WILDLIFE HABITAT

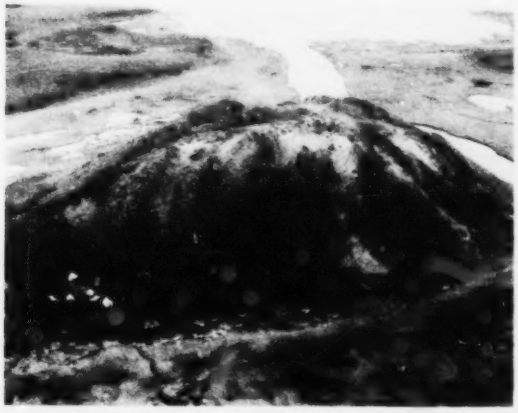
When planning your seismic operation you should be aware of any critical wildlife habitat along the route. Access through game and bird sanctuaries may be restricted to avoid disturbing wildlife during activities such as egg incubation and rearing of young. The local land use office can direct you to the appropriate government departments to obtain more information on the locations and restrictions of these areas.

• avoid beaver dams and ponds

Unique Geographical Features

AVOID PINGOS

One of the unique permafrost landforms is a pingo – a round, ice-cored hill formed as a result of water and ice pressures in permafrost terrain. Pingos are most common on the Mackenzie Delta. Machinery, vehicles, and equipment are prohibited within 150 m of these landforms. This restriction is necessary because of the sensitivity of the pingos to surface disturbance.



• travel within 150 m of pingos is not permitted

Archaeological Sites and Monuments

AVOID ARCHAEOLOGICAL SITES

Because evidence of past cultures helps us to understand our heritage, land use operations in proximity of known or suspected archaeological sites and burial grounds are prohibited. Known sites are registered, and routing assistance to avoid them can be obtained through the local land use office.

REPORT ARCHAEOLOGICAL FINDS

Many archaeological and historical sites have yet to be discovered. If artifacts, such as arrowheads and pottery, old encampments, or buildings are encountered, operations must be stopped and the land use inspector notified.

DO NOT DISTURB BOUNDARY MONUMENTS

A boundary monument is a fixed point used to officially mark the boundary of any surveyed lands or is established for any surveying purpose. Monuments are labelled and can be a post, stake, peg, mound, pit, trench, or any object. Monuments must never be moved, knocked over, damaged, or destroyed, but if by accident they are, the incident must be reported at once to the Surveyor-General at the office of Energy Mines and Resources Canada in Yellowknife or Whitehorse. The Surveyor-General will require payment for the investigation and restoration of the monument.

Commercial Forests

AVOID COMMERCIAL FORESTS

Timber salvage will be required where seismic lines cut through commercial forests, woodlots, and areas of commercial timber. The land use engineer can help in determining the location of these areas. Avoidance of these areas, if possible, will be to your advantage.

Mining Claims

NOTIFY HOLDERS OF MINING CLAIMS

In the Yukon, holders of placer and hard rock claims crossed by your proposed seismic line must be notified. The location and names of holders of mining claims can be obtained from the Mine Recorder's Offices in the area crossed.

Traplines

NOTIFY TRAPPERS

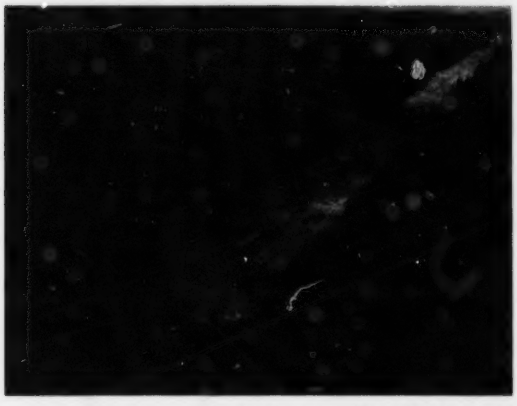
Trappers whose traplines will be crossed by your seismic line should be informed of your intended activity. In the Yukon, trappers' concession maps are available from the Yukon Territorial Government Department of Renewable Resources. In the Northwest Territories where there are few, if any, registered traplines, contact the band councils, the Trappers' Association, and the Territorial Government Department of Renewable Resources for information on trapping areas.

• notify trappers if your seismic line will cross a trapline

Pipelines

NOTIFY PIPELINE OWNERS

If your proposed seismic line crosses a pipeline right-of-way, the owners of the pipeline should be notified and information on pipeline burial depth and special crossing procedures obtained. You may be requested to use ramps when moving vehicles and equipment over the pipeline in order to avoid damaging or rupturing the pipe.



• ramps may be required when moving vehicles and equipment over a pipeline

SCOUTING

SCOUT THE LINE

A field examination of the proposed route will allow the identification of site-specific terrain problems, a first view of potential stream-crossing sites, and an assessment of special and unique areas.

The scout can also contact communities (mayor, town manager, or band chief) and interest groups (mining claim holders, Trappers' Association) at this time. Although communities and interest groups are normally contacted by INAC as part of the review process, it is to the permittee's advantage to make the initial contact and explain the proposed program. Meetings such as these allow the scout to learn of site-specific concerns (line crosses important trapline, old cemetery, etc.) which can then be considered prior to submission of the land use permit application.

• scout the line to identify potential problems

• assess stream crossings and identify shoofly locations

CONTRACTOR CONSIDERATIONS

The geophysical contractor who will carry out the seismic survey should be provided with all the relevant information collected along the proposed route. The contractor should carry out his own route reconnaissance and, as the line progresses, meet with the representatives of local communities.

MEET WITH THE LAND USE INSPECTOR

The contractor must schedule a pre-initiation meeting between himself and the land use inspector for the project. Ideally, the land use permit permittee should also be present. This meeting will serve as a forum to review the terms and conditions of the land use permit and establish the lines of communication between the contractor and the land use inspector.

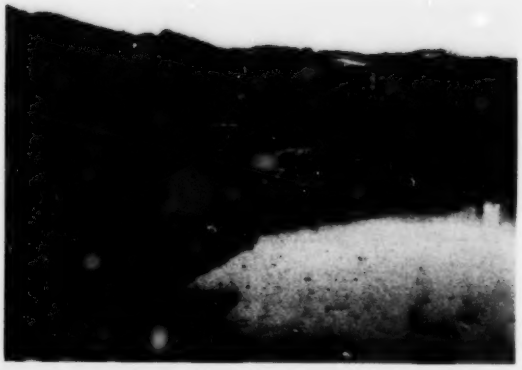
• meet with your land use inspector and establish lines of communication before initiating field operations

SCHEDULING

Scheduling of seismic operations must take into consideration the condition of the ground surface. In general, the surface must be strong enough to support the activity without allowing excessive rutting or disturbance to occur.

IN PERMAFROST TERRAIN, RESTRICT SEISMIC OPERATIONS TO WHEN THE GROUND IS FROZEN

Because of the sensitivity of permafrost terrain to disturbance, and because a large proportion of the Northwest Territories and Yukon is covered by permafrost, most overland movement, except on multi-season roads, is restricted to times when the ground is frozen. As a result, most seismic operations must take place during the months December through April. In permafrost areas, off-road travel in summer is prohibited unless special permission has been obtained from the land use office. Exceptions to these regulations do exist, and in areas of stable surficial materials and ice-free permafrost, off-road travel may be allowed in summer. The local land use office will be able to assess specific cases.



- **schedule your project to avoid being caught by spring break-up**
- **extensive surface disturbance may result in your project being shut down and vehicles being abandoned until the next winter**

Seismic Operations Planning Worksheet

This worksheet highlights the major points discussed in the handbook. It should be used as a reference to assess compliance with land use permit conditions and as a check for sound environmental planning during all phases of a seismic operation. Page numbers following each question refer to where further information on the topic is available in the handbook. If the answer to any question is "no" the reader should give some more thought to that aspect of the project.

PLANNING

- Has initial contact been made with the land use engineer? (p. 9) Yes ____ No ____
- Has information been collected on terrain, climate, and land use? (p. 9) Yes ____ No ____
- Have maps of existing seismic lines, roads, and trails been checked? (p. 9) Yes ____ No ____
- Have other seismic operators who have worked in the area been contacted? (p. 9) Yes ____ No ____
- Have existing rights-of-way been used? (p. 10) Yes ____ No ____
- Has ice rich terrain been avoided? (p. 8,10) Yes ____ No ____
- Have steep slopes been identified and shooflies been located? (p. 11) Yes ____ No ____
- Have locations of water bodies been identified and 30 m buffers been maintained? (p. 11) Yes ____ No ____
- Are important wildlife habitats avoided? (p. 11) Yes ____ No ____
- Does the route alignment avoid pingos by at least 150 m? (p. 11) Yes ____ No ____
- Have records been searched for the presence of archaeological sites? (p. 12) Yes ____ No ____
- Have commercial forests been avoided? (p. 12) Yes ____ No ____
- Has notification been given to all holders of mining claims? (p. 12) Yes ____ No ____
- Has notification been given to trappers? (p. 12) Yes ____ No ____
- Has notification been given to pipeline owners? (p. 13) Yes ____ No ____
- Has the line been scouted? (p. 13) Yes ____ No ____
- If the contractor has been selected, has he met with local community representatives? (p. 13) Yes ____ No ____
- Does the schedule for operations take into account that activities can take place in permafrost areas only when the surface is frozen? (p. 14) Yes ____ No ____

PERMITS

- Has a land use permit been applied for? (p. 5) Yes ____ No ____
- Has the holder of the mineral rights made the application? (p. 5) Yes ____ No ____
- Have you allowed sufficient lead time for a review of your application? (p. 6) Yes ____ No ____
- Have all same-season followup surveys been included in your application? (p. 5) Yes ____ No ____
- Are burning permits required? (p. 5) Yes ____ No ____
- Are fisheries permits required? (p. 5) Yes ____ No ____
- Have you read your permit and do you understand the terms and conditions attached? (p. 6) Yes ____ No ____
- Have you and the contractor met with the land use inspector? (p. 6) Yes ____ No ____

Name _____ Telephone _____

CLEARING

- Do the types of equipment planned to be used coincide with those indicated on the land use permit? (p. 19) Yes ____ No ____
- Is clearing being restricted to the approved right-of-way? (p. 19) Yes ____ No ____
- Have stream crossings been scouted and finalized? (p. 24) Yes ____ No ____
- Are efforts being made to decrease the right-of-way width at stream crossings? (p. 20) Yes ____ No ____
- Have wider areas for camps and equipment turnarounds been incorporated in clearing? (p. 20) Yes ____ No ____
- Have clearing crews been instructed to minimize surface disruption to prevent erosion? (p. 20) Yes ____ No ____
- Has the surface vegetation cover been maintained? (p. 20) Yes ____ No ____
- Has hand clearing in sensitive areas been undertaken? (p. 20) Yes ____ No ____
- Have leaners been removed? (p. 21) Yes ____ No ____
- If partial disposal is being used are crews slashing, lopping, and scattering? (p. 21) Yes ____ No ____

- Is roll back being undertaken on doglegs and at streams? (p. 22) Yes ____ No ____
- Is salvageable timber being limbed, bucked, and stacked properly? (p. 22) Yes ____ No ____
- If windrowing, has machinery spread and walked the windrow to promote decay? (p. 22) Yes ____ No ____
- Have breaks been left in windrows? (p. 22) Yes ____ No ____
- Has brush disposal been carried out progressively with clearing? (p. 22) Yes ____ No ____

ON LINE OPERATIONS

- Has travel been confined to approved rights-of-way? (p. 23) Yes ____ No ____
- Has the crew been advised to suspend travel before rutting occurs? (p. 23) Yes ____ No ____
- Have streams not amenable to fording been identified to the crews? (p. 24) Yes ____ No ____
- Is ice depth being checked at ice bridges? (p. 25) Yes ____ No ____
- If blasting to loosen snow fills, has a blasting permit been obtained? (p. 25) Yes ____ No ____
- Are multiple cats being used for moving sleighs? (p. 26) Yes ____ No ____
- Are water intakes screened? (p. 27) Yes ____ No ____
- If working from a stationary camp, has the camp layout been sketched to ensure proper placement of the sump, garbage pit, water intakes, etc.? (p. 25) Yes ____ No ____
- Is the crew informed that garbage is not to be disposed of in the sump? (p. 28) Yes ____ No ____
- Is garbage being burned daily? (p. 28) Yes ____ No ____
- Is non-combustible garbage being handled in accordance with the land use permit? (p. 28) Yes ____ No ____
- Is fuel stored in accordance with the land use permit conditions? (p. 30) Yes ____ No ____
- Is fuel stored at least 12 m above the high water mark of a water body? (p. 30) Yes ____ No ____
- Are fuel tanks being checked regularly for leaks? (p. 30) Yes ____ No ____
- Have fuel storage sites been reported to the land use inspector? (p. 30) Yes ____ No ____
- Have all seismic lines and shot holes been marked? (p. 30) Yes ____ No ____

CLEAN-UP AND RESTORATION

- Is clean-up and garbage disposal taking place progressively with the operation? (p. 31) Yes _____ No _____
- Are shot holes and craters being backfilled? (p. 31) Yes _____ No _____
- Is debris being removed from drainageways? (p. 32) Yes _____ No _____
- Is revegetation required in any area? (p. 32) Yes _____ No _____
- Are erosion control measures required in any area? (p. 32) Yes _____ No _____
- Was the land use inspector consulted regarding abandonment of airstrips and access roads? (p. 32) Yes _____ No _____
- Have the details of the final land use plan been discussed with the land use engineer? (p. 32) Yes _____ No _____

NOTES AND SKETCHES

Chapter 5
Clearing

Once planning has been completed and the land use permit and any other required approvals obtained, field operations can commence. In treed areas, the first step will normally be flagging and clearing. The amount of clearing required will depend upon the extent to which existing seismic lines, access roads and trails, and frozen water bodies have been incorporated into the line during the planning phase.

• **restrict clearing to the width of the seismic line right-of-way**

CUTTING THE LINE

Equipment

The types of equipment used for clearing will depend on the terrain conditions which will themselves depend on the presence or absence of permafrost and the time of year. Tracked vehicles work best for winter seismic operations although the use of wheeled vehicles may be possible after tracked vehicles have compressed the surface. The use of wheeled vehicles may be restricted by the extensive preparation of the travel surface required in areas of heavy brush or by terrain conditions such as hummocks on the tundra.

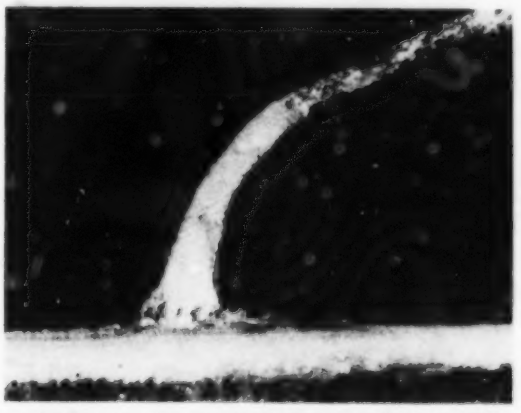
Tracked dozers can be used to clear most seismic lines except on steep or unstable terrain where, if re-routing is not possible, hand clearing of the line will be required.

• **hand clear steep or unstable terrain to minimize the potential for erosion**

Where to Clear

MINIMIZE THE AREA CLEARED

Minimizing the area cleared is both environmentally and economically wise. Reducing the area cleared will reduce clearing costs, minimize wildlife habitat loss, and decrease the potential for erosion, especially on slopes and stream approaches. Clearing should normally be restricted to the width of the seismic line right-of-way. Doglegs may be required by the land use inspector at approaches to major highways, navigable rivers, major lakes, and some pipeline rights-of-way. The land use inspector will give written notification where doglegs are required.



• **a dogleg may be required at approaches to major highways, rivers, lakes , and some pipelines**

The width of right-of-way required for a survey will depend upon terrain conditions, the type of survey, and the type of equipment used. Normally, a 10-metre wide right-of-way will be required, assuming a tracked, sleigh-mounted camp and the use of vibrators. Adjustments are made to the width of the right-of-way based on:

(1) Type of seismic survey and equipment used

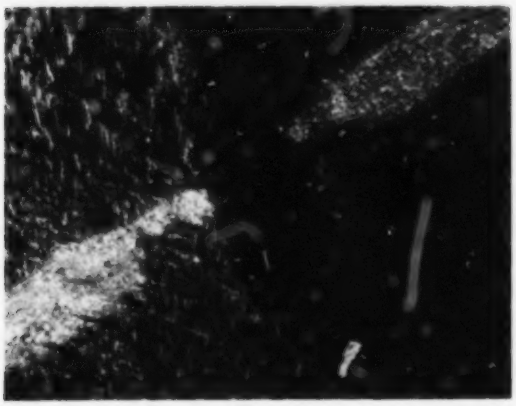
- Dynamite surveys do not require as wide a right-of-way as vibrator surveys
- Receiver lines for 3-D surveys can be narrower than the main line
- Seismic surveys carried out using wheeled vehicles (such as from a stationary camp in non-permafrost areas) do not require as wide a right-of-way as surveys using tracked vehicles

(2) Environmental conditions

- Efforts should be made to minimize the right-of-way width at stream crossings
- In areas of large trees a wider right-of-way will be needed to separate the cut trees from the standing timber unless spray cutting (pushing trees down into the adjoining forest with an angled blade) is used

A wider cleared area will be required for camps and equipment turnaround points. The best locations for these sites are naturally-open areas which will not require additional clearing.

Adhere to guidelines concerning activities near water bodies as presented in Chapter 6.



• decrease right-of-way width at stream crossings when possible

How to Clear

MINIMIZE SURFACE DISRUPTION

Clearing should be carried out in a manner that will minimize surface disturbance and prevent erosion. In permafrost areas, as discussed in Chapter 3, disruption of the organic mat must be avoided because of the mat's role as an insulator of the permafrost. Even in non-permafrost areas, disruption of the surface by improper clearing practices can result in erosion.

• avoid excessive blading of the organic mat

MAINTAIN SURFACE VEGETATION COVER

Where possible, low shrub and ground vegetation should be kept intact. This vegetation preserves soil stability and acts as a sediment filter near waterways.

Clearing of seismic lines is best accomplished by felling the trees along the right-of-way. Walking-down vegetation is usually not an appropriate clearing technique because it makes travel back up the line very difficult.

Except where the technique of spray cutting is approved, trees should be felled onto the right-of-way to minimize disturbance to the adjoining forest. Do not fell trees across traplines or pipelines. Trees should always be felled away from watercourses.

HAND CLEAR SENSITIVE TERRAIN

In ice-rich permafrost areas, on steep or unstable slopes, and at stream crossings with unstable banks, hand clearing should be used to minimize surface disturbance and reduce erosion. Hand clearing should also be used near lakes to prevent the pushing of brush into the lakes.

• use spray cutting only where approved

REMOVE LEANERS

When clearing, care should be taken to ensure that trees partially knocked over during clearing are not left leaning over the right-of-way or hanging in the surrounding forest. The weight of the leaning tree may lever roots out of the ground, disrupting the organic layer and removing insulation for the underlying permafrost. These trees can also be a safety and fire hazard.

• remove leaners – they can be a safety hazard

BRUSH DISPOSAL

Brush from clearing operations may be disposed of by:

- Total disposal consisting of burning or burying
- Partial disposal, consisting of slashing, lopping, and scattering; or windrowing.

Your land use permit will specify which method is applicable to your operation.

Total Disposal

Total disposal is normally not required for seismic lines, although it may be a condition in the vicinity of major road crossings. If total disposal is required, you will be notified in writing by your land use inspector.

• properly cleared debris – rolled back and walked down

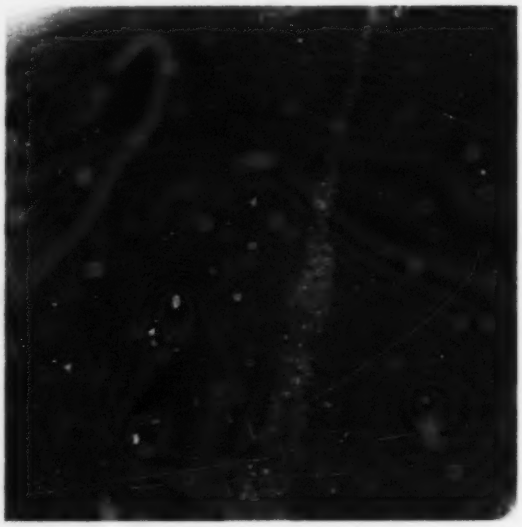
Partial Disposal

SLASH, LOP, AND SCATTER CLEARED TREES

When spray cutting has been used as a clearing technique and the trees do not fall flat on the ground, branches must be removed and the stems cut into lengths so that all parts of the tree lie on the ground. This contact with the ground speeds up decay of the brush and debris. Lopping and scattering should also be used to dispose of timber from hand-cut lines and clearings.

ROLL BACK BRUSH ON DOGLEGS AND AT STREAMS

Brush disposal on doglegs or at streams may include spreading the cut vegetation onto the line following the survey. This serves both aesthetic and erosion control purposes. In the latter case, the brush acts as a sediment trap. For the same reasons, the land use inspector may instruct you to push the brush back around the corner of a dogleg for incorporation into a windrow.



• satisfactory roll back in heavy timber

TIMBER SALVAGE MAY BE REQUIRED

If your line passes near a road to a settlement and if the inhabitants could use the wood for firewood or at a mill, timber salvage may be a condition of your permit. If this is the case, the timber should be limbed, bucked, and left in piles near the line.

WINDROW BRUSH

When windrowing is the disposal method, the brush is piled at the side of the right-of-way and heavy machinery is used to spread and compact the windrow to promote faster decay.

Windrows may be placed on either side of the right-of-way but if placed on the downhill side they offer the advantage of serving as a sediment trap. To reduce the fire hazard, windrows should not be pushed against

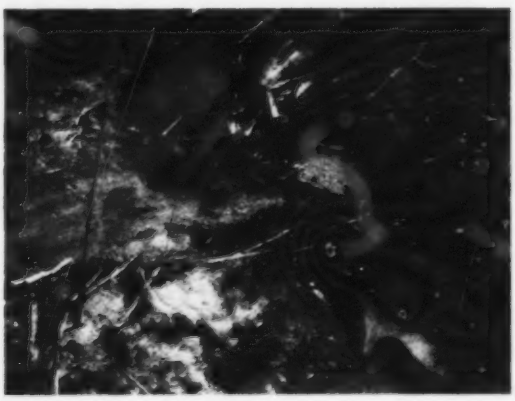
• salvaged timber should be limbed, bucked and stacked near the line

standing timber. Leaving a buffer between the windrow and standing timber also allows easier fighting of fires in windrows. Breaks of from 5 to 10 m should be made in windrows at intervals of about 300 m to prevent the piled brush from acting as a wick in the event of a fire. Fires have been known to travel along an unbroken windrow. In addition to breaks at 300-metre intervals, additional breaks should be made at traplines, pipelines, and skidoo trails.

DO NOT DISPOSE OF BRUSH IN WATER BODIES

DISPOSE PROGRESSIVELY

In no case is disposal of brush in water bodies allowed. Disposal should be carried our progressively with clearing. Proper disposal along the whole route must be completed prior to the expiration of the land use permit.



• disposal of brush in water bodies is not permitted

Chapter 6
On-Line Operations

In this chapter, activities associated with conducting the seismic survey are discussed and guidelines presented. Topics covered are travel on the line, activities near water bodies, camps, fuel supplies, and seismic survey techniques. Many of the topics are applicable to clearing operations as well.

TRAVEL ON THE LINE

CONFINE TRAVEL TO EXISTING RIGHTS-OF-WAY

To minimize new disturbances, existing roads and seismic lines should be used for travel as much as is practical. Consideration should be given to travelling on frozen river channels. Tracked vehicles or those with balloon tires and low bearing pressure can be used to minimize disturbance to permafrost.

Avoid travel off the right-of-way. Since travelling on lands not approved by the land use engineer is not allowed, indicate any expected off right-of-way travel on your land use permit application. If unexpected off right-of-way travel becomes necessary, obtain permission from your land use inspector beforehand.

• confine travel to your approved right-of-way

• meandering is not allowed

• travel on frozen river channels when practical

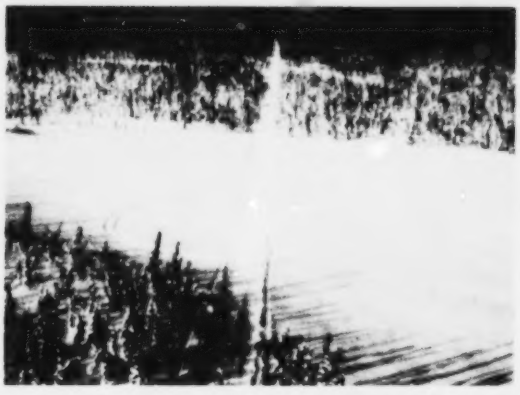
SUSPEND TRAVEL BEFORE RUTTING OCCURS

One of the terms of your land use permit will be to suspend travel before rutting of the surface occurs. Rutting usually occurs around spring break-up as the ground thaws. If this happens before your seismic program is completed, consider working at night when temperatures are lower, to finish up or move equipment out. If this is not possible, discuss with your land use inspector the potential for leaving certain equipment on the line over summer and flying the survey crew out.

• suspend travel before the surface becomes soft and susceptible to rutting.

WATER BODIES

The intersection of seismic lines with water bodies and drainageways is unavoidable. Because water bodies often provide habitat for fish and wildlife, their preservation and protection are important aspects of land use permit terms and conditions. The means of preserving and protecting water bodies from the effects of seismic operations is through prevention of bank erosion and stream sedimentation. The time to begin addressing potential impacts to water bodies is at the planning stage.



• avoid cutting banks when approaching water bodies

MINIMIZE CONTACT WITH WATER BODIES

Most of the damage to water bodies occurs as a result of erosion on land near shorelines and stream banks. This can be minimized by:

- Approaching water bodies only when crossing is necessary, otherwise maintaining a 30-metre buffer between the seismic line and water body, if possible
- Crossing at right angles to minimize the amount of contact with a stream

FINALIZE STREAM CROSSINGS PRIOR TO MOVING EQUIPMENT

Stream crossing sites should be determined during the planning stage. The sites should be finalized in the field prior to moving any heavy machinery. Use snowmobiles or light-weight vehicles for scouting a crossing.

To minimize environmental impacts at stream crossings:

- Select gentle approaches, whether naturally-occurring or constructed. Crossings are best made at low-lying areas with minimal banks.
- Avoid cutting stream banks as this results in sedimentation of the stream. If cutting is required, obtain authorization from your land use inspector who will inform the local fisheries officer.
- Minimize or eliminate in-stream activities as these can stir up sediment; restrict stream-flow; injure or kill fish, beaver, and muskrat; and divert the course of a stream.
- Prevent the deposition of debris, soil, and organic material in the stream. Do not fill an intermittent stream channel or gully with soil to serve as a crossing.

Streams can be crossed by fording or by using an ice bridge or snow fill.

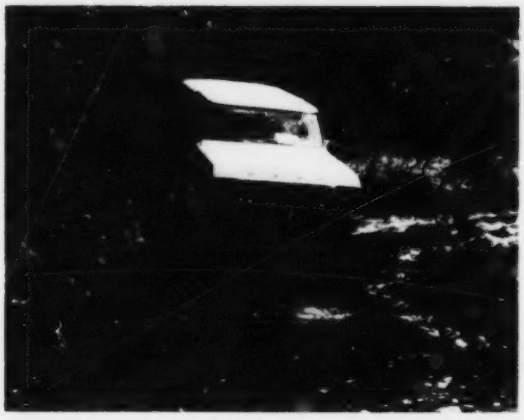
Fords

Fords across streams with running water may be acceptable providing the following conditions are met:

- Fish populations in the stream are low
- The approach to the stream is gentle
- The stream bed is composed of gravel or cobbles

DO NOT FORD STREAMS WITH SILTY BEDS

Streams with silty beds should not be forded because of the potential damage to fisheries habitat caused by siltation.



• check streambed and bank conditions before fording stream

Ice Bridges

The construction of an ice bridge involves clearing the ice of snow to allow deeper freezing and flooding the surface, as required, to support the weight of vehicles and machinery. If flooding is carried out, the ice should be built up in shallow lifts as these will freeze harder than deeper lifts.

Ice bridges may contain limbed trees if permission to do so is obtained beforehand. The trees will have to be removed prior to breakup. Ice bridges without logs can be left to melt on their own when abandoned unless there is a likelihood of damming and flooding if done so. The bridge may, however, be loosened with a small dynamite charge. Discuss the need for a blasting permit from Fisheries and Oceans with your land use inspector prior to using dynamite. The construction of dirt ramps on the ice are not allowed because of the increased sediment loads which will occur upon melting of the ice.

DO NOT ALLOW ICE BRIDGES TO RESTRICT WATER FLOW

If flowing water is present in a stream and an ice crossing interferes with the flow, minimize vehicle time spent on the crossing. This will reduce the amount of ice depression and water flow restriction. If an ice crossing freezes to the stream bed, your land use inspector may request you to break the resultant ice dam. Full-depth freezing of a normally flowing stream will have a detrimental effect on overwintering fish and aquatic mammals. As well, full-depth freezing will normally cause icings both upstream and at the crossing itself. These icings not only pose a traffic hazard as they spread beyond the stream banks, but the forces exerted by the ice can damage or destroy trees and brush along the stream and stimulate erosion.

• constructing a snow-filled crossing

Snow Fills

DO NOT USE SOIL OR DEBRIS IN SNOW FILLS

Snow fills used to cross streams should not contain soil or other foreign debris and must be removed before breakup. Complete removal of the fills may damage stream banks and in some cases is not required. The goal in removing snow fills is to restore stream flow and avoid damaging fish habitat. If the fill is composed of clean snow, this goal may be achieved by cutting a V-shaped notch at the middle of the stream with a cat. The rest of the fill will be removed by the stream at breakup. Snow fills may also be loosened using a small dynamite charge. This will allow spring runoff to remove the snow more easily and will minimize the flooding potential. Place the charge at mid-depth of the fill. A blasting permit may be required from Fisheries and Oceans for this activity – discuss it with your land use inspector beforehand.

• the use of soil to cap a snow fill is an unacceptable practice

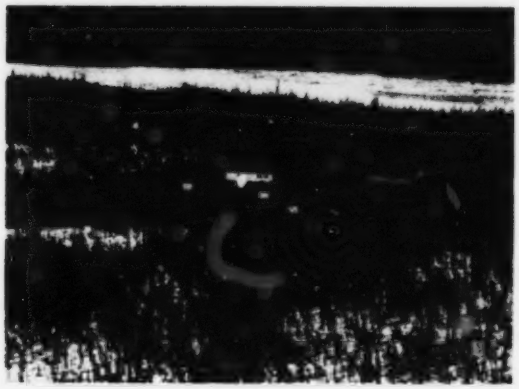
CAMPS

Seismic camps can be either stationary or mobile. This section addresses both types together; guidelines pertaining to only one type are addresed separately, as necessary.

Where to Locate

PLAN FOR MULTIPLE USE OF CAMP SITES

Because a seismic operation may include both a drilling camp and a recording camp, plan for multiple use of sites by subsequent camps (e.g. locate your recorder camp at the site of the earlier drill camp).



• a stationary seismic camp located in an area of sparse timber, back from the river

USE PREVIOUSLY-CLEARED AREAS FOR CAMPS AND TURNAROUNDS

Locate camps close to a water supply and, if possible, in natural clearings or previously-cleared areas. North of the tree line, camps should be located on high ground for protection against drifting snow.

Where seismic operations are carried out from stationary camps, such as is common in the southern part of the Northwest Territories, locate camps on gravel surfaces in open areas back from water bodies. To minimize site clearing, use cleared areas from old camps, if possible.

• location of this mobile camp on high ground minimized problems due to drifting snow

Movement

USE MULTIPLE CATS FOR MOVING CAMPS

When moving camps, use two or three cats instead of only one. The extra cats reduce the surface disturbance on slopes by providing additional traction for pulling the sleighs. Locate turnarounds for camps in muskeg, not bush, to reduce the need for additional clearing.

When moving camps, equipment, or supplies by barge, remember that portable ramps may be required.

• the use of two cats to move this camp reduced surface disturbance

Storage of Camps

ELEVATE CAMPS STORED OVER SUMMER

If seismic camps have to be stored over summer, elevate the trailers on logs to avoid extensive depression of the ground surface and runners freezing into the ground. Permission to store a camp on federal lands may be included as part of the land use permit. A permit from INAC is not required to store the components of a camp on community land (Commissioner's land), however the local municipality must be contacted and appropriate approval received.

• store trailers on skids to avoid depressing the ground surface

Water Supply

The supply of water to a seismic camp is addressed under the Public Health Ordinances for Northwest Territories and Yukon. Contact the local Environmental Health Officer to discuss your water supply needs.

SCREEN WATER INTAKES

If a mobile camp is parked on a frozen river, pump water from the river for camp use. Screen all water intakes to prevent fish from being taken up by the pumping. Minimize the amount of water removed from fish-bearing streams with low water levels.

Waste Water and Sewage

Most seismic camps are mobile and remain at one site for no more than a few days. As such, waste water and sewage can be disposed of on land. Churning of the disposal area by vehicle and machinery traffic as the camp is abandoned will help disperse the waste and dilute its concentration in the soil.

Where mobile camps are on ocean ice, waste water and sewage can be left on the ice for dilution by natural processes. Waste water and sewage from camps on freshwater bodies should be disposed of on plastic liners and allowed to freeze. The frozen waste and the liners should be scraped up and disposed of on land when the camp is closed down.

CONSTRUCT SUMPS FOR STATIONARY CAMPS

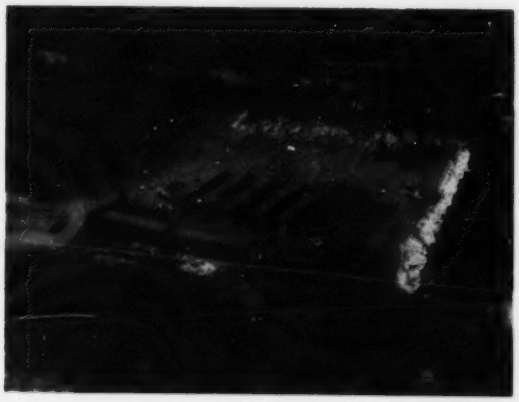
• mobile camps parked at one site for no more than a few days can dispose waste water and sewage on land

Sumps for waste water and sewage disposal are required for stationary seismic camps. Sump location should adhere to the following criteria:

- Locate the sump downslope and down wind from the camp.
- Locate at the sump downstream from the camp water source and at least 12 m above the high water mark of any water body.

The shape of the sump depends on camp layout. A long, narrow sump servicing several trailers may be the best arrangement.

Construct your sump deep enough to contain the estimated volume of waste waters from the camp plus enough volume for a one-metre freeboard.



• stationary seismic camps require an excavated sump for waste water and sewage

• a long narrow sump behind several trailers may be the best configuration

DO NOT DISPOSE OF GARBAGE IN THE SUMP

Do not dispose of residue from incinerated garbage in the sump. Frost heave may transport this material to the surface after the camp and sump have been abandoned. Transport the residue to approved landfill sites for disposal. When abandoning the camp, backfill the sump, building up a small cap to allow for subsidence.

- **combustible garbage must be incinerated**
- **daily burning is recommended**

Garbage

BURN GARBAGE DAILY

Contain garbage prior to disposal. The containment and disposal of garbage, aside from health and aesthetic reasons, eliminates the potential for wildlife problems created by the attraction of wildlife to garbage.

- **kitchen garbage which has not been incinerated may be dug-up by animals**

Combustible garbage from camps must be burned, preferably in forced-air fuel-fired incinerators. Daily burning is recommended.

FLY OUT OR BURY NON-COMBUSTIBLE GARBAGE

In permafrost areas, fly out non-combustible garbage. Alternatively you may drill a hole and bury the non-combustibles, covering the hole with a berm. If the material is not adequately covered, frost heave may bring it to the surface requiring a return in spring for further clean up.

In non-permafrost areas, bury non-combustible garbage, where permitted. If the area is sensitive to erosion, transport non-combustibles to the nearest settlement for disposal. Obtain approval from the community before commencing this latter action.

- **a properly restored campsite – all garbage has been disposed of, the sump has been backfilled, and the clearing debris spread out and walked down**

Camp Access

Air

LOCATE AIRSTRIPS ON FROZEN WATER BODIES

If camps are to be serviced by air, pre-plan your airstrip locations, preferably on frozen water bodies. Allow adequate time for clearing to ensure that the camp has not passed the strip by the time it is ready for operation.

If flare pots are used to mark an airstrip, ensure they are tight and not leaking fuel. Consider using portable beacons for airstrips.

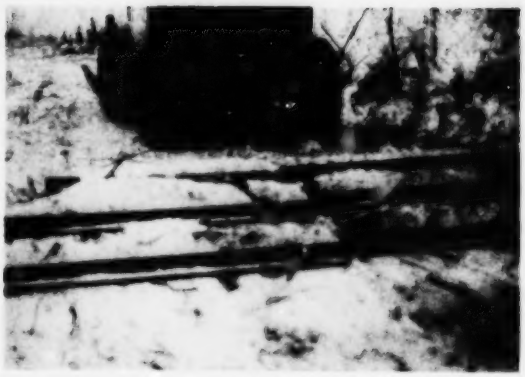
• **airstrip and camp on a frozen lake**

Road

DO NOT USE CUT-AND-FILL FOR ROADS

Roads can provide access between seismic camps or between a camp and a community. These roads are temporary facilties and efforts should be made to minimize the amount of disturbance during their construction and operation. Do not use cut-and-fill methods to prepare roads for use by wheeled vehicles; simply drag the route to prepare the surface. If seismic lines are being used for access, do not drag as this will remove the caps from the shot holes.

• **excessive blading of this access road has removed the snow and surface organic mat and greatly increased erosion potential**



• **dragging of the road will prepare a smooth surface for travel**

In hilly terrain, maintain drainage on side-slope cuts. Erosion control may be required on steep slopes.

• **construction of snow berms and timber roll back will protect this slope from erosion**

If a stationary camp is used, plan your seismic grid to have seismic lines running off the camp access road. By using the access road to transport your seismic equipment, you may be able to reduce the width of the seismic lines.

More information on access road construction is contained in the publication "Land Use Guidelines Access Roads and Trails" available from your local INAC office.

Fuel Supply

Environmental problems associated with fuel movement and storage will be minimized by adhering to the following procedures.

Fuel trucks and storage tanks must be labelled indicating their contents as required by the Hazardous Goods Act.

Transportation of fuel over rough terrain is best carried out by fuel trucks with a low centre of gravity. These trucks offer greater stability and are less likely to overturn when encountering the terrain along seismic lines.

• fuel trucks (sleighs) with a low centre of gravity, are best suited to transport fuel over rough terrain

STORE FUEL AWAY FROM WATER BODIES

Store fuel at least 12 m above the high-water mark of any lake or stream. Storage sites should be on flat, stable terrain or in natural depressions away from water bodies.

Fuel supply sites at fixed camps must be bermed if any single tank stores more than 4000 litres. Valves on fuel tanks should have a receptacle beneath them to catch leaked fuel. Nozzles with automatic shut-off valves are recommended.

INSPECT FUEL CONTAINERS FOR LEAKS

With the exception of the container in use, all fuel container outlets must be kept sealed to prevent leaking. Containers should be inspected regularly for leaks which, when detected, should be repaired immediately.

Land use conditions usually require that mobile fuel facilities that are likely to be stationary for more than 12 hours be located on land.

The locations and contents of all fuel caches must be reported to the land use inspector so that the sites can be included in the inspection program.

SEISMIC SURVEY TECHNIQUES

If carrying out a dynamite survey, remember that all use of explosives must comply with the territorial blasting ordinances and with all COGLA regulations. Blasting on ice or in water will also require a fisheries permit.

In some areas, gas hydrates may be present in drill holes. The review of previous seismic surveys during the planning activities should determine whether your survey will cross such an area. If it does, park your rig into the wind so that any gas hydrates will be dissipated.

MARK LINES AND SHOT HOLES

The marking of seismic lines and shot holes may be a requirement of your land use permit. Markers help locate lines in the tundra and polar desert and are useful for the operator if he has to return to carry out detailed follow-up surveys along the line.

Chapter 7
Clean-up and Restoration

TIMING

CLEAN UP PROGRESSIVELY

Progressive clean-up is the most efficient approach. However, snowfall may limit the effectiveness of progressive clean-up by covering garbage until spring. If clean-up is progressive, inspection of the line should be progressive as well so that undesirable conditions can be addressed at that time.

• **geophone wire left on the line can kill wildlife**

CLEAN-UP REQUIREMENTS

Garbage

Clean-up is required for waste items generated during a seismic operation. Capwire and pin flags should be disposed of in the garbage pit, burned, or removed.

• **this garbage should have been picked up and properly disposed of.**

Shot Hole

BACKFILL SHOT HOLES AND CRATERS

Shot holes should be backfilled with cuttings and plastic plugs. Trees may also be used for plugging. Holes with flowing water should be plugged with rubber inflatable plugs and cemented.

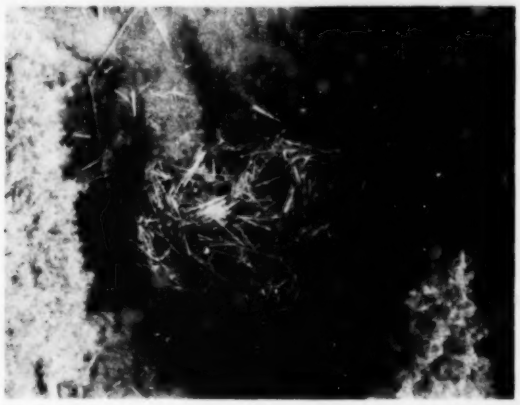
Craters may occur with shot holes in gravel where the charge is near the surface or if water gets into the top of the hole and freezes, forming an air pocket between the ice and the charge. Craters should be backfilled.

• **craters should be backfilled**

Drainageways

CLEAN OUT DRAINAGEWAYS

Windrows and debris should be removed from small drainageways to ensure that flow is restored. Revegetation may be required if drainageway banks are cut.



• **all clearing debris must be removed from drainageways**

Airstrips

Airstrips should be abandoned if there is a likelihood they will not be reused. Consult with your land use inspector prior to abandonment. Flarepots, fuel barrels, and debris should be removed. A good fuel inventory program will ensure that all barrels are accounted for.

• **remove all fuel barrels when abandoning an airstrip**

Access Roads

Access roads are generally left open unless in a dangerous state. The primary requirement for clean-up and restoration is the removal of debris from drainageways to minimize the potential for erosion. Consult your land use inspector for direction.

Slopes

Reclamation requirements for slopes are normally identified at an early meeting with the land use inspector. Erosion control in the form of cross ditches, breakers, or revegetation may be required. The land use inspector can provide revegetation specifications if required.

• **revegetation of disturbed areas, particularly on slopes, may be required**

REPORTING

Within 60 days of expiration of the permit, the permittee must file a final land use plan with the land use engineer who will issue a letter of clearance. The final land use plan must indicate land used, including any amendments to the land used as indicated in the land use permit application. Final clearance is withheld until after spring breakup when the snow has gone and a final inspection is made.

Recommended References

Indian and Northern Affairs Canada, 1982. Environmental Guidelines Pits and Quarries.

Indian and Northern Affairs Canada, 1983. Land Use Guidelines Mineral Exploration Yukon and Northwest Territories.

Indian and Northern Affairs Canada, 1984. Land Use Guidelines Access Roads and Trails.

Indian and Northern Affairs Canada, 1986. Environmental Operating Guidelines: Hydrocarbon Well-sites in Northern Canada.

Indian and Northern Affairs Canada, 1987. Reclamation Guidelines for Northern Canada.

All handbooks are available from INAC offices in Ottawa, Yellowknife, and Whitehorse.

List of INAC Offices

NORTHWEST TERRITORIES

Regional Manager, Land Resources
INAC
P.O. Box 1500
Yellowknife, N.W.T.
X1A 2R3

District Superintendent
INAC
P.O. Box 2500
Yellowknife, N.W.T.
X1A 2P8

District Manager
INAC
P.O. Box 658
Fort Smith, N.W.T.
X0E 0P0

District Manager
INAC
P.O. Box 2100
Inuvik, N.W.T.
X0E 0T0

District Manager
INAC
P.O. Box 150
Fort Simpson, N.W.T.
X0E 0N0

District Manager
INAC
Ranklin Inlet, N.W.T.
X0C 0G0

District Manager
INAC
Iqaluit, N.W.T.
X0A 0H0

Resource Management Officer
INAC
P.O. Box 1420
Hay River, N.W.T.
X0E 0R0

Resource Management Officer
INAC
P.O. Box 126
Norman Wells, N.W.T.
X0E 0V0

YUKON TERRITORY

Regional Manager, Land Resources
Attention: Land Use Section
INAC
200 Range Road
Whitehorse, Yukon
Y1A 3V1

Resource Management Officer
INAC
P.O. Box 289
Watson Lake, Yukon
Y0A 1C0

Resource Management Officer
INAC
Teslin, Yukon
Y0A 1B0

Resource Management Officer
INAC
200 Range Road
Whitehorse, Yukon
Y1A 3V1

Resource Management Officer
INAC
P.O. Box 5370
Haines Junction, Yukon
Y0B 1L0

Resource Management Officer
INAC
Beaver Creek, Yukon
Y0B 1A0

Resource Management Officer
INAC
Carmacks, Yukon
Y0B 1C0

Resource Management Officer
INAC
Ross River, Yukon
Y0B 1S0

Resource Management Officer
INAC
P.O. Box 100
Mayo, Yukon
Y0B 1M0

Resource Management Officer
INAC
P.O. Box 279
Dawson City, Yukon
Y0B 1G0